has size amplitude, which is analogous to fusional amplitude, would be perfectly comfortable with this correction because he could compensate for the induced size. Another patient who is sensitive to size changes, or in using the fusion sense as a comparison, having weak fusion powers, low ductions, etc., would not be able to compensate for induced size and, consequently, would not be relieved of his asthenopic symptoms by the correction; the symptoms would, indeed, be increased in severity by the induced aniseikonia. In regard to the Velez case, it is important to note the increases in fusional amplitude while wearing the iseikonic correction. After wearing the iseikonic lenses for three days, it required but one prism degree to break fusion in abduction, two degree prism to break it in adduction. After two months it required approximately six degrees to break abduction, and ten degrees to break adduction. The vertical ductions had similarly increased. Doctor Bielschowsky has presented conclusive proof that this patient's remarkable relief of symptoms, double vision, etc., was not due to suggestion or psychotherapy.

Through the work of Doctor Ames and his group we are now in possession of a new factor in the primary causation of strabismus. Aniseikonia makes it impossible to maintain comfortable binocular vision. The eyes deviate from parallelism in the sense of a flight strabismus, suspension taking place and amblyopia ex anopsia following in the deviated eye.

There is another phase of this remarkable work which is being done by Doctor Ames and his group at Dartmouth, namely, that phase of the work which is in relation to cyclophoria. Cases of cyclophoria have up to the present often been missed or ignored. Past attempts to relieve by changing the axis of the cylinder or by reducing its amount, orthoptic training and surgery on the oblique muscles, have been more or less unsatisfactory.

The present eikonometer measures only aniseikonia at axis, 90 or 180 or over-all aniseikonia. In order to test for off-axis or meridional aniseikonia, Doctor Ames has perfected an instrument which he calls the tipping field, or tilting or flying field. It consists of two stippled ground glass plates giving an impression of depth. For the far tests, the plates are in the horizontal position; for the near tests, in the vertical. The subject is required to adjust them in what appears to be to him the perfect horizontal or vertical plane. From the position of the plates, declination or conclination can be diagnosed, vertical tilt designating the declination and horizontal the conclination. Tilting forward denotes the presence of incyclophoria, tilting backwards the presence of excyclophoria. By means of a scale these can be measured to a degree. By this means the off-axis of an aniseikonia can be measured and corrected. Doctor Ames and his coworkers found that cyclophoria produced such a tipping field abnormality; that it can be measured and be corrected by proper iseikonic lenses. Cyclophoria is corrected, or strain relieved when aniseikonia is present, by equalizing the image sizes in the proper meridian; or in the absence of aniseikonia an artificial aniseikonia is induced by iseikonic lenses with resultant reflex cyclophoria in the opposite direction of that present.

Many cases of hitherto uncorrectable fatigue for near work, poor depth perception (aviators making poor landings), photophobias of unknown origin and many so-called neurasthenic patients have been completely relieved by correcting the apparent cyclophoria in this way.

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GEORGE N. HOSFORD, M. D. (490 Post Street, San Francisco).—I am sure we all owe Doctor Brandenburg a debt of thanks for bringing to us a first-hand account of this new development in physiologic optics. I have but little patience with the criticisms leveled at this amazing piece of work, particularly when they emanate from those who have not studied it. The discoveries of Dr. Frank W. Weymouth and his collaborators on retinal grain may prove to be the anatomic basis on which it rests. It may well be the unknown factor in both the etiology and treatment of strabismus for which investigators have been looking in vain for so many years.

We should have predicted some such development to account for some of the unexplained phenomena in ophthalmology, just as astronomers have predicted the presence of a new planet from mathematical calculations made before the planet was ever seen through the telescope. The discovery of aniseikonia, and of a method of correcting it with lenses, may well give us another means of dealing with squint, which may be even more important than anything yet applied to the problem.

MODERN TRENDS IN ANESTHESIA*

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ALMOST a century has elapsed since the discovery of anesthetic agents and their application in clinical practice. Prior to this time the successful surgeon was usually a young man of iron nerve, who was capable of undertaking rapid but merciless operative procedures. Anesthesia opened wide vistas for successful surgical research and achievement. The surgeon no longer has to be young, daring, and ruthless; he still must have nimble and dextrous hands, but the guiding brain may be a mature one, which is influenced by a wealth of experience. Anesthesia has made possible, in great degree, the remarkable development in surgery. Patients have come to expect relief of pain during surgical procedures, and they are becoming more and more insistent that pain be relieved in medical and obstetric practice as well.

ANESTHETIC AGENTS IN OBSTETRICS

Chloroform.—Chloroform has retained, in many localities, its popularity as an anesthetic agent that is capable of relieving, to a great extent, the pain that is encountered in the process of childbirth. This drug has been favored over ether because of its greater power to produce analgesia. The present trend is to eliminate the use of both these agents during labor. Patients are demanding, and obstetricians are putting greater stress on, the relief of pain that is encountered early in labor. It has become quite a general custom to administer a derivative of barbituric acid in repeated small doses by mouth, for example, pentobarbital sodium, three grains (0.20 gram) when dilatation of the cervix has reached two centimeters. This dose may be repeated as it seems advisable. Care must be exercised in order to avoid the occurrence of undue restlessness. The total dose of the barbiturate may be kept minimal if morphin is administered in conjunction with it. Morphin, grain one-sixth, is frequently found beneficial, but its administration must be limited to the early hours of labor;[7] otherwise the baby may be cyanotic and apneic at birth.

Barbiturates.—The barbiturates find their most effective application when they are administered intravenously to patients exhibiting convulsive seizures of eclampsia. The convulsions may be

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controlled; the patient is provided with an interval of rest, during which therapeutic measures may be undertaken or, if it is deemed wise, operative delivery may be accomplished.

Colonic Anesthesia.—Oil-ether (colonic) anesthesia has been given thorough clinical trial since its introduction by Gwathmey and his associates [2] in 1923. Many patients have a high regard for this method of relieving pain, and many obstetricians favor its use. The method is probably best reserved for primiparas, or for multiparas who experience difficult and prolonged labor. The rectal administration of tribromethyl alcohol (avertin) has been advocated for the same type of patient, but general use of this drug has not become an established and well-recognized practice.

Gaseous Anesthetics.—For the pain of the late first stage and in the second stage of delivery, administration of gaseous anesthetics is desirable. Nitrous oxid and ethylene are useful and valuable, but, because of the problem of portability of the apparatus that is required, administration of these gases is, to a great extent, limited to patients who are delivered in a hospital. The new gas, cyclopropane, offers advantages [1] over nitrous oxid and ethylene. It is capable of producing more satisfactory analgesia than nitrous oxid and ethylene, and the concentration of oxygen in the mixture is so high that there should never be any excuse for the presence of cyanosis. It possesses the same disadvantages of excessive cost as do nitrous oxid and ethylene, and the apparatus required for its administration is not readily portable. Administration of this gas to a patient who is undergoing cesarean section is well worth while. Adequate relaxation may be obtained without the production of cyanosis and without the use of ether. The baby cries shortly after delivery, the uterus maintains adequate tone, and hemorrhage is not likely to be excessive.

ANESTHETIC AGENTS IN INTERNAL MEDICINE

Barbiturates.—The barbiturates have a definite place in the treatment of convulsions that are caused by eclampsia, tetanus, meningitis, or strychnin poisoning.[5] From 5 to 15 grains (0.3 to 1 gram) of sodium amytal, administered intravenously, will control convulsions, conserve the strength of the patient, and provide the clinician with an interval in which to administer other treatment. Patients who are suffering from toxic psychosis may be controlled in the same way. Satisfactory sedation can be maintained by repeated administration of the drug rectally. The dose that is required is smaller than that which is administered in the initial intravenous injection, and since the patient's tolerance is known, rectal administration is safe. The rectal method of administration may be employed in cases in which it is feasible, or the solution can be deposited in the stomach through a Rehfuss tube that is introduced through the nose. If it is necessary to maintain sedation for several days, considerable fever may develop as the result of the disease and from the effect of the barbiturate. Constant observation for the appearance of pulmonary edema must be maintained. With these untoward symptoms in evidence, the barbiturate may be temporarily discontinued and tribromethyl alcohol (avertin) may be administered instead. By raising the foot of the bed and by administering oxygen by means of a nasal catheter, the pulmonary edema may be controlled. Hiccough has been controlled by the oral administration of either sodium amytal or pentobarbital sodium (nembutal), supplemented by intermittent inhalations of carbon dioxid, 10 per cent, and of oxygen, 90 per cent. Patients who have syphilis and suffer from gastric crisis sometimes gain relief following the intravenous administration of a barbiturate. The injection should be made slowly, because these patients frequently exhibit respiratory depression and cyanosis, following the administration of as small a dose as 5 grains (0.3 gram) of sodium amytal. An individual who has delirium tremens may be given a barbiturate intravenously in order to produce a period of rest. It is advisable to give 3 milligrams of ephedrin with each cubic centimeter of solution containing 1½ grains (0.097 gram) of sodium amytal. The amytal tends to lower the blood pressure and the ephedrin tends to offset this action. The anesthetist, who is experienced and familiar with methods of administration of the barbiturates and other drugs that are capable of producing sedation, should make an excellent consultant in these troublesome cases.

The anesthetist may be of assistance to the clinician in making a diagnosis in certain types of cases. A patient may consult a physician because of pain in the region of the lower part of the face, lower jaw, and neck. The clinician is likely to find that the pain is atypical in type, and that it does not correspond to any pain that is produced by involvement of the fifth cranial nerve. This type of pain may be sympathetic in origin. In order to decide this point, the anesthetist may be called on to block the sympathetic trunk with procain, as it passes down over the anterolateral aspect of the eighth cervical, and first and second dorsal vertebrae. The anesthetist may be certain he has successfully blocked the sympathetic trunk if a Horner's syndrome is obtained on that side. If the pain is abolished by this procedure, a cervicodorsal sympathectomy may be considered. This same method of injection may be employed in cases of Raynaud's disease in which there is some doubt whether the desired dilatation in the peripheral vessels of the fingers may be obtained by cervicodorsal sympathectomy. A bilateral block of the sympathetic trunks in the region of the eighth cervical, and the first and second dorsal vertebrae, will produce a maximal rise in temperature of the fingers to 34 or 35 degrees centigrade, provided there is little pathologic change in the peripheral vessels. Failure to obtain this rise in temperature of the fingers in cases in which a Horner's syndrome has been produced indicates the presence of peripheral vascular change which cannot be completely overcome by cervicodorsal sympathectomy. Under these circumstances, complete relief of symptoms that are referable to the hand cannot be produced by operation. Spinal an-

esthesia may be induced if the same question arises regarding the advisability of undertaking a lumbar sympathectomy for relief of symptoms referable to the feet. By inducing spinal anesthesia in a case in which the patient is suffering from hypertension, one may gain an impression of the extent one may reduce that pressure by dividing the anterior spinal roots that emerge from the sixth dorsal to the second lumbar vertebrae, inclusive. Again, it may be possible for the anesthetist to relieve the pain of a patient suffering from angina pectoris by blocking, paravertebrally, with one per cent solution of procain, the upper five dorsal nerves on the left side. If the pain is relieved by this procedure, 5 cubic centimeters of 95 per cent alcohol may be injected in the region of each nerve to give relief from pain for six to ten months. Pain in old scars in the upper part of the abdomen may be relieved by blocking the involved nerve or nerves in the intercostal groove, with procain. Once the offending nerve is located, alcohol may be injected, or a surgeon may be called to resect it. These are a few of the many cases in which the anesthetist and the clinician may coöperate, to the advantage of the patient.

ANESTHESIA FOR SURGICAL PROCEDURES

The development in the art and science of anesthesia has reached the stage where the surgeon can expect, and can reasonably demand, a great deal of the anesthetist. He may expect the anesthetist to know the pharmacologic action of many sedative and anesthetic drugs. He may expect him to be familiar with the methods of their administration. In addition, the anesthetist should be prepared to evaluate the operative risk in relation to the operation and several methods of producing anesthesia which might be used. The surgeon may expect advice regarding the anesthetic agents and methods of administration which are likely to produce the best operative conditions, and at the same time assure the patient the best chance for recovery. The anesthetic and method of its administration having been decided on, the anesthetist should know the proper preliminary medication to prescribe. During these investigations the anesthetist should instill in the patient a confident outlook. Regional anesthesia should be instituted without undue pain, and general anesthesia should be induced pleasantly and rapidly. Irrespective of the site of operation, the anesthetist should be able to maintain anesthesia satisfactorily with the patient in optimal position for the surgeon, and in special instances he should be prepared to provide positive pressure during thoracotomy or quiet breathing for difficult operations which involve structures in the upper part of the abdomen. The surgeon should be able to depend on his anesthetist's evaluation of the patient's condition throughout the operation. The anesthetist should know the accepted methods for preventing, delaying or treating untoward reaction, whether it be surgical shock, respiratory arrest, or circulatory depression. In some surgical organizations, it is the anesthetist's responsibility to administer saline, dextrose, or acacia intravenously, and to administer blood transfusions. In any case, the anesthetist should be in a position to institute remedial measures promptly. The anesthetist should visit the patient in the immediate postoperative period and should be prepared to institute intravenous medication or oxygen therapy, and to maintain proper sedation. Thus, the modern anesthetist can aid the surgeon in many ways.

The present trend in anesthesia is toward careful selection of the proper anesthetic agent or combination of agents and, after that selection has been made, toward securing optimal results from their administration. The trend has led to a diversification in anesthetic agents and methods of their administration. Chloroform for surgical anesthesia is rapidly passing from the scene. Substitutes for ether are being introduced. New methods of administration are being developed constantly, and old methods are being refined. Although the majority of patients can be anesthetized satisfactorily by the use of ordinary anesthetic agents and methods, there is an advantage in using special agents and methods in about 35 per cent of the cases.

Avertin. — Tribromethyl alcohol (avertin) was introduced in Germany in 1926.[12] It is used as a substitute for Gwathmey's oil-ether preparation in rectal anesthesia. Originally, complete surgical anesthesia was attempted, but a dose large enough to produce this result was found to be unsafe. Experience has taught that the use of this agent is best limited to the production of basal anesthesia, the intention being to reinforce its effect with a gas, small amounts of ether being added if necessary.

Rectal administration is not a convenient method, and particular care must be taken in preparation of the enema containing tribromethyl alcohol. In the presence of pulmonary tuberculosis with cavitation, disease of the liver, and lesions of the large intestine, administration of this agent per rectum is contraindicated. In the main, results obtained with tribromethyl alcohol have been good. Patients choose the method if they have ever had any experience with it.

There are other methods, however, which seem to give equally good results. In view of the fact that deaths have been reported, following the administration of even relatively small doses of tribromethyl alcohol, other methods are to be preferred. In preparing patients for surgical anesthesia, fear and apprehension are allayed following the administration of a barbiturate in small doses. For example, 1½ grains (0.1 gram) of pentobarbital sodium may be administered the night before operation, and this dose may be repeated when the patient awakes in the morning. About forty-five minutes before the operation, 1/6 grain (0.01 gram) of morphin and 1/150 grain (0.0004 gram) of atropin may be administered hypodermically. At this time, a capsule containing 1½ grain (0.1 gram) of pentobarbital sodium may be administered if further sedation is necessary.

Evipal Soluble. — Within recent years, search for a short-acting barbiturate has proved successful. One of the newest derivatives to be given

clinical trial in this country is known as evipal soluble.[8] Another preparation, which is not yet on the market, is designated by the manufacturer as No. 8064. It is considerably more potent than is evipal soluble. Satisfactory anesthesia for short operations has been produced by the intravenous injection of a 10 per cent solution of either evipal soluble or No. 8064. No more than 15 grains of either of these agents should be administered at one time. Either of these anesthetizing solutions should be injected at the rate of one cubic centimeter in fifteen seconds, until light general anesthesia is produced. Usually, not more than two cubic centimeters of either of these solutions is required to produce this effect. Injection is then halted until the patient shows some evidence of reaction, when the injection is resumed at a reduced rate; a small amount is administered intermittently to maintain anesthesia at the desired level. Like other barbiturates, evipal soluble is capable of depressing the activity of the respiratory center. The dose should be regulated entirely by the effect produced, rather than on any basis of milligrams per kilogram of body weight.

Evipal soluble and allied derivatives of the barbituric acid series have produced satisfactory anesthesia for short operations, such as incision of abscesses, extraction of one or two teeth, enucleation of an eye, puncture of the tympanum, spinal puncture for diagnosis, cystoscopic examination, or for the removal of packs from painful wounds. These drugs appear to produce anesthesia which is satisfactory for minor surgical procedures and short operations, during which slight reflex movement will not interfere with the progress of the procedure.

Divinyl Ether.—Divinyl[3] ether has been introduced and suggested as a substitute for diethyl ether. My experience with this agent is limited to a comparatively few cases, and I do not feel that I am in a position either to recommend or to condemn this new drug. It is much more potent than is diethyl ether; anesthesia is induced quickly and recovery is attained rapidly. My impression is that the results were not as satisfactory as those which were obtained with diethyl ether. Maybe the fault was in my administration, and it is probable that satisfactory methods for the administration of this drug satisfactorily will be devised.

Cyclopropane.—Cyclopropane, which was introduced by Lucas and Henderson[4] in 1929, and which was recommended for clinical use by Waters, and Schmidt,[11] shows promise of displacing ethylene. It greatly reduces the amount of ether that is necessary to produce thorough relaxation. The limits of inflammability of cyclopropane in oxygen are from 2.5 per cent to 50 per cent by volume. In clinical practice, the volume of cyclopropane in oxygen seldom needs to exceed 20 per cent. The same precautions must be taken to prevent an explosion as would be taken to prevent an explosion of ethylene. Because the gas is expensive, it is necessary to employ the carbon dioxid absorption method of administration. Anesthesia is induced rapidly and the patient seldom exhibits a period of excitement. Surgical anesthesia is attained rapidly, without evidence of cyanosis. Excessive depression of respiration and a newly developed irregularity in cardiac action represent the danger signs. Relaxation approaches that which is produced by ether. Recovery is rapid and is not accompanied by excessive nausea and vomiting. This anesthetic agent deserves a place among the useful anesthetics, but the problem is for the chemist to find an inexpensive method of producing the gas in pure form on a commercial scale.

Intratracheal Tube. — Ninety per cent of the difficulty that is encountered in the administration of an anesthetic by inhalation may be avoided by the insertion of an intratracheal tube. A Magill[6] intratracheal soft rubber tube of large caliber may be inserted through the nose or mouth, and then through the glottis into the trachea. If introduction by way of the nose is feasible, it should be possible to insert it in the trachea without the aid of a laryngoscope in 70 per cent of cases. The tube is used as an airway when ether is administered by the open drop method, or it may be connected to a gas machine, and gas, with or without ether, may be administered either by insufflation or inhalation.

The method permits easy, quiet respiration that facilitates exposure in operations in the upper portion of the abdomen and reduces intracranial pressure in operations on the brain. In certain operations on the head and neck, it precludes the necessity of the apparatus and the anesthetist's hands encroaching on the field of operation. For operative procedures within the chest, the method facilitates the control of intrapulmonary pressure. The safety of the patient is increased because artificial respiration or insufflation of oxygen is made easy and the danger of overdistending the stomach is eliminated.

LOCAL, REGIONAL, AND SPINAL ANESTHESIA

New agents have been introduced in the field of local, regional, and spinal anesthesia.

Procain.—Procain, in my opinion, still remains the agent of choice for these procedures. Procain may produce evidence of toxic reaction. Several factors are to be considered. Among the important factors are the age, weight, and blood pressure of the patient; concentration and temperature of the solution; total amount used, and rate of injection. Epinephrin has long been used to produce vasoconstriction and thus retard absorption of the procain, but occasionally the epinephrin itself causes a toxic effect. As a substitute, a synthetic product, cobefrin,[10] has been introduced and is being investigated. Usually the addition of one cubic centimeter of a 1 to 2600 solution of epinephrin to 200 cubic centimeters of a 0.5 per cent solution of procain will produce satisfactory vasoconstriction, intradermally and subcutaneously. In order to obtain a similar result, it is necessary to use 1 cubic centimeter of a 1 to 500 solution of cobefrin.

Procain is practically useless as a surface anesthetic for application over open wounds or ulcers. Pantocain, metycain, diothane, butyn, and nupercain have been applied effectively in the form

TABLE 1.—*Combined Use of Pantocain and Procain in Spinal Anesthesia*

Operation	Combined dose, mg.		Total physiologic saline solution, spinal fluid, cc.
	Pantocain	Procain	
Hysterectomy, Mayo vaginal	8	50	2.5
Fulguration within urinary bladder	10	50	3.0
Transplantation of ureter	12	50	3.5
Herniorrhaphy (bilateral)	12	50	3.5
Hysterectomy, complete abdominal	12	50	4.0

Spinal needle, gauge 20 to 22; rate of injection, 0.5 cc. per second; injection between second and third lumbar vertebrae.

of ointments or gels, but if the wound is large the more toxic of these agents produce signs of toxemia, namely, pallor, nausea and vomiting, and a slow pulse. These signs and symptoms have disappeared when administration of the drug is discontinued. The rationale of the use of these drugs is to produce relief of pain locally rather than by using analgesics which act systemically.

Procain is used extensively for the production of anesthesia by spinal injection; but if it is likely that the operation cannot be completed in one hour, a combination of pantocain and procain[9] may be used (Table 1). In my opinion, the dose of pantocain should be limited to approximately 10 milligrams. Usually not more than 50 milligrams of procain need be injected with it to produce anesthesia which will last from an hour and a quarter to two hours. Because pantocain is exceedingly potent, and because it tends to creep cephalad during the first twenty minutes of the operation, I consider it advisable to limit the use of this drug to operative procedures which involve structures below the umbilicus. In order to prevent anesthesia extending too far cephalad, the patient, for twenty minutes following an intradural injection of pantocain, should be kept in the horizontal position.

Sacral Block. — Sacral block is a time-tried method, but it is not as generally used as it might be. For operative procedures that involve the anus and rectum, it is the anesthetic method of choice. One may produce just as thorough anesthesia and relaxation with this method as with spinal anesthesia. In cases in which the sacral method has been employed, the patient is less likely to retch and vomit during the operation than he is if intraspinal anesthesia has been employed; and in the postoperative period there is no occurrence of headache from lumbar puncture.

Local Anesthesia.—For many orthopedic operations on the extremities, local anesthesia is satisfactory. For acute fractures, 10 cubic centimeters of a 1 per cent solution of procain may be injected into the hematoma. Anesthesia and relaxation of the muscles may be obtained. One does not need frequently to block the brachial plexus, but there are instances in which the method may be very useful. In cases in which severed tendons of the hand and wrist are to be sutured, blocking the brachial plexus provides ideal anesthesia. Many of these patients arrive in the hospital shortly after having partaken of a heavy meal. General anesthesia is, therefore, hazardous. By blocking the brachial plexus, complete sensory anesthesia may be obtained, but motor power is frequently retained. The patient is able to move certain muscles when he is told, and the surgeon is thus aided in finding the proper ends of severed tendons, which should be sutured together.

IN CONCLUSION

There are many other desirable methods which might be dealt with, but it has been sufficiently demonstrated that if an anesthetist fulfills his function in the scheme of things medical, he is practicing medicine in the fullest sense of the term.

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